

The Structural Diagnostic Toolset (TSDT)

Module III - Invariant Calculator

Formal Perimeter Specification

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Abstract

The Invariant Calculator (IC) is a perimeter module of the Structural Diagnostic Toolset (TSDT) derived from the Relative Framework. It evaluates whether a proposed system configuration is Admissible, Necessarily Transitional, or Impossible under structural constraints, cumulative irreversibility, and finite resolution capacity. The module does not forecast events, timelines, or outcomes. It detects invariant preservation or identity loss.

1. Design Axioms

- A1. All real systems are constrained.
- A2. All non-trivial systems experience irreversible information loss.
- A3. System identity is defined by invariant preservation.
- A4. Resolution capacity is finite.
- A5. Prediction beyond constraint is undefined, not uncertain.

Systems violating these axioms fall outside module scope.

2. System Formalisation

$S = (X, C, R, I, K, \rho)$

X - State space

$C \subseteq \wp(X)$ - Constraint sets (disallowed configurations)

$R : X \rightarrow X$ - Transition relations

$I \subseteq \wp(X)$ - Invariants preserving identity

$K \in \mathbb{R}_{\geq 0}$ - Cumulative irreversible information loss

$\rho \in \mathbb{R}_{> 0}$ - Resolution capacity

If a system cannot be expressed in this form, classification returns UNDEFINED.

3. Metric and Projection Primitives

$\delta(x,y)$ - Domain-appropriate distance metric on X .

$||\cdot||$ - Norm on X consistent with δ .

Π_C - Projection operator mapping any state to nearest admissible constraint surface.

These primitives must be specified or approximated for application.

4. Constraint and Invariant Functions

Constraint distance:

$$d_C(x) = \min_{\{c \in C\}} \delta(x, c)$$

Invariant validity:

$$\chi_I(x) = 1 \text{ if } x \in \cap I, \text{ else } 0$$

Invariant violation constitutes identity loss.

5. Structural Conflict Function

$$\Phi(x) = \sum_{\{r \in R\}} || r(x) - \Pi_C(r(x)) ||$$

Measures divergence between unconstrained and admissible evolution.

6. Irreversibility Condition

$K_{\{t+1\}} = K_t + \Delta K_t$, where $\Delta K_t \geq 0$.

No reversibility assumption permitted.

7. Resolution Capacity

$$\rho = \sup \{ \Phi(x) \mid \exists x' \in X \text{ such that } \chi_I(x') = 1 \}$$

ρ represents maximum conflict absorbable without identity loss.

ρ is fixed during evaluation.

8. Relative Stress Functional

$$\Sigma(x) = (\Phi(x) + K) / \rho$$

Dimensionless, monotonic, unbounded above.

9. Classification Mapping

If $\Sigma(x) < 1$ and $\chi_I(x) = 1 \rightarrow$ ADMISSIBLE

If $\Sigma(x) = 1$ and $\chi_I(x) = 1 \rightarrow$ NECESSARY-TRANSITION

If $\Sigma(x) > 1$ or $\chi_I(x) = 0 \rightarrow$ IMPOSSIBLE (IDENTITY LOSS)

Outputs are mutually exclusive and exhaustive.

10. Operational Procedure

1. Define system and invariants.
2. Specify constraints and transition relations.
3. Estimate K .
4. Compute or bound $\Phi(x)$.
5. Evaluate $\Sigma(x)$.
6. Return classification.

The module reports structural status only.

11. Interpretation Constraints

ADMISSIBLE does not imply optimality.

NECESSARY-TRANSITION does not specify direction.

IMPOSSIBLE indicates identity loss under continuation.

The module functions as a boundary detector.

12. Scope

Detects:

- Structural impossibility
- Necessity of reconfiguration
- Admissibility under constraint

Does not predict:

- Events
- Timelines
- Outcomes

13. Structural Integration Statement

Under admissible divergence, monotonic irreversibility, finite resolution capacity, and invariant preservation, the Invariant Calculator constitutes a deterministic perimeter divergence module within TSDT.

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